Reduction of Water Consumption and Wastewater at Gavrilovic Meat Processing Plant

Project Title: Cleaner Production: Reduction of Water Consumption and Waste Waste Water Production at Gavrilovic Meat Processing Plant in Petrinja, Croatia
Leader: Gavrilovic Ltd.
Partner: Universal Aqua Technologies, Inc.
Location: Petrinja, Croatia
Project Duration: November 1999 - March 2000
EcoLinks Project Investment: Total EcoLinks Project Investment: $118,270: EcoLinks Grant Support: $25,680; Project Team Cost Share Contribution: $92,590.

Best Practice: Transferable Solutions

This project is a Best Practice because it provides a template for processing plants seeking to improve water and energy efficiency and reduce production costs. It is especially impressive because it represents a re-building of infrastructure in a former war zone. Other plants similar to the Gavrilovic meat processing plant in Petrinja, Croatia can refer to this Best Practice for effective tools and techniques to reduce water and energy consumption while improving economic efficiency. The impacts and savings generated from implementing a water management program and exploring co-generation make Gavrilovic more environmentally friendly and competitive in a free market system.

Project Summary

Gavrilovic is a meat processing plant in Petrinja, Croatia. As a result of being located in a former war zone, plant operations have been hindered in many ways. The plant's wastewater treatment facility, for example, was destroyed during the recent war and needs to be rebuilt. The entire plant currently operates at only 30% of its capacity. In order to increase production and avoid wasting limited water and energy resources, the company must improve its facilities and become more efficient.

Gavrilovic uses larges amounts of water (approximately 2000 m3 of water each day) in its production process. Water is used for product sterilization, generating steam, cleaning the plant, and cooling purposes. The plant's water costs account for up to 53% of total production costs. It is high in minerals and causes build up in the pipes and heat transfer equipment leading to unnecessarily high operation costs. Slightly polluted, used water from the factory flows through the non-functioning water treatment plant and into the Kuba River.

In 1998, Gavrilovic joined a program called, "Capacity Building for Cleaner Production" supported by UNIDO and the Croatian government with direct support from the Croatian Ministry of Economy and the State Directorate for Protection of Nature and Environment. The purpose of this program is to develop and apply technical and organizational measures that prevent environmental problems providing environmental and economic benefits for industrial enterprises. With the support of an EcoLinks Challenge Grant, Gavrilovic demonstrates its commitment to this program by initiating a project to reduce water consumption and wastewater effluent.

The goal of this project was to improve water and energy efficiency at Gavrilovic. In collaboration with a US firm based in California, Universal Aqua Technologies, Gavrilovic developed a water management program and a feasibility study on the cogeneration of heat and electric energy. To promote water savings and lower production costs, a system for recycling water and co-generating heat and electricity was developed.

To develop a water savings plan for the entire plant, water consumption was measured and analyzed using flow meters. A pilot water re-circling facility was developed and installed. Upon reviewing the results of the pilot project, further suggestions for improving water efficiency at the plant were proposed.

Several benefits are derived from the implementation of a full-scale water management program at Gavrilovic as developed in this project. For example, Company savings are estimated at $81,670 per year by improving water-use practices, installing a water re-circulating facility, and collecting and processing rainwater. The Water Management Plan promotes a 30% decrease in water consumption from six million to four point five million cubic meters. The total wastewater load is reduced by 23%. A water re-circling facility, as revealed by the pilot study, allows for the reduction of 56 tons of suspended substance and 20 tons of fat in water effluent.

Project Activities

The implementation of this project involved a series of actions. These actions are described below. By offering a detailed outline of the methods used in this project, others with similar environmental and economic problems can replicate appropriate steps and apply the relevant technologies.

1. Installed and Activated Flow Meters

Action: Flow meters were installed in the can sterilization room and in the boiler room. They were supervised and controlled to monitor, collect and process data generated by the meters.

Product(s): 1) installed flow meters 2) data on water flow patterns.

2. Developed Water Management Plan Concept

Action: Water consumption was audited and water consumption rates were analyzed.

Product(s): Compliance parameters regarding water consumption and demineralization for a water re-circling facility were established 2) Monitoring procedures and data processing methods for water re-circling were developed 3) Water Management Plan outlining water savings strategies based on water consumption and effluent patterns.

3. Installed pilot water recycling facility

Action: A pilot reverse-osmosis, water-recycling unit was designed, constructed, and transported to Croatia. Its performance was analyzed and adjusted as needed. Additional flow meters were installed in the engine room on the cooling towers and in the sausage cooking facility. Flow meters are eventually to be installed at all points where water is consumed to establish a comprehensive understanding of water use at the plant.

Product(s): 1) Installed reverse-osmosis, water recycling unit.

4. Trained staff and provided staff informational materials

Action: The staff that does the washing and cleaning of containers and the facilities was trained in water management to introduce the new system and to promote efficient water use.

Product(s): 1) Water saving measures and guidelines for use by staff 2) Staff implementation capacity of the water management program through an increased level of awareness of the possibilities for saving water.

5. Implemented and improved water management

Action: The pilot re-circling facility was activated and audited. Monitoring and data collection and analysis were conducted. Testing the pilot facility helped to determine the volume of water to be re-circled. Based on the data collected and analyzed during monitoring of the pilot water recycling facility, a feasibility study was conducted and improvements were generated.

Product(s): 1) Feasibility study of pilot water recycling unit.

6. Conducted final assessment and produced recommendations

Action: The project leader and project partner in collaboration with the Gavrilovic management assessed the results of the project and produced recommendations based on these results.

Product(s): 1) List of next steps and on-going activities 2) Presentation of project results at the Fourth International Conference, "Water Supply and Water Quality" in Krakow September 11-13, 2000 3) A student project was prepared for the National Competition in Chemistry for high school students in which the possibilities for saving water at Gavrilovic were explored; the project received the highest grade of five.

Project Benefits

This project established the possibility for accruing certain benefits by applying a particular methodology and using certain technologies. Capacity building benefits are generated through raising the awareness of the importance and needed steps for implementing water efficiency measures. The Gavrilovic staff, for example, now possess valuable skills and knowledge on how to save water by improving clean-up procedures. Environmental benefits include a reduction in water pollution. Significant economic benefits are generated from reducing water consumption.

Capacity Building Benefits

This project raised community awareness of the importance of water saving strategies both from an economic as well as an environmental perspective. The staff at Gavrilovic has a knowledge base and guidelines now that allow it to participate in providing significant water savings. The results of the project were shared at the Fourth International Conference, "Water Supply and Water Quality" in Krakow in September, 2000 promoting the techniques and tools for reducing water consumption and improving efficiency. Others interested in implementing a water management program can now look to Gavrilovic for successful strategies and technologies.

Through this project, a set of institutional mechanisms has been initiated that allow Gavrilovic to promote further environmental and economic benefits. As a follow-up to this project, the plant has decided to continue water consumption data collection and analyses until the full balance of water flow is measured by the main plant's flow

meter and all in-house flow meters. The plant also decided to install three reverse-osmosis water treatment units and to install the cogeneration plant. Various options for obtaining finances (loans) are being analyzed.

Environmental Benefits

This project demonstrates methodologies and technologies for 1) reducing pressure on important resources including water and gas and 2) minimizing water pollution. These environmental benefits are outlined below.

- Water consumption is reduced by 30%, from 6.0 to 4.5 million m3 per year. This is an immediate result of the implementation of low-cost, "good housekeeping" measures as measured by the factory's main flow meter. Further reductions in water consumption (minimum 20% of the present demand) are expected after installing the reverse-osmosis treatment unit and closing water–wastewater loops.
- Following the decreased demand for water, the stream of wastewater that needs to be treated in the treatment plant before release into the Kupa River will be proportionally decreased (by 30-50 %).
- The reverse-osmosis, water-treatment unit not only will purify water but also demineralize it. Using demineralized water in the boilers will secure a longer service life of installations and facilities and reduce the consumption of gas needed for water heating.
- The constant analysis of water supply requirements allows for the ongoing efficient use of water.
- The training and education of plant staff in water conservation improves their ability to implement environmental practices at the plant.

Economic Benefits

This project demonstrates the possibility for significant economic benefits. Full application of the Water Management Program will reduce costs associated with water consumption levels, operations, and water treatment.

Implementation of the water efficiency measures in the Water Management Program at Gavrilovic provides the following savings on a yearly basis:

Reduced water consumption due to good housekeeping measures	$170,000
Return of the condensate (enabled by installation of reverse-osmosis unit)	$28,000
Recycling of water from cooling system - (enabled by installation of reverse-osmosis unit)	$11,000
Recycling of water from can sterilization (enabled by installation of reverse-osmosis unit)	$17,500
Collecting and processing of rainwater 25,000 m3/year (enabled by installation of reverse-osmosis unit)	$25,000
Total savings	$ 251,500

Table 1. Economic Benefits from Water Efficiency

By implementing other measures outlined in the Water Management Plan, there are additional benefits:

- Reduction in the plant's operating costs by 20% ($130,000 per year), in addition to savings from decreased water demand. For example, the life of the equipment that transfers water can be extended with the use of demineralized water. Lower operation costs result from the decreased need for maintenance and replacement of parts and from reduced electricity consumption associated with heating the water used for sterilization.
- Reduction in water treatment costs. The volume of treated water is reduced from 1500 m3 per day to 1000 m3 per day, resulting in a savings of $500 per day or $150,000 per year.
- A simple pay back period of less than two years on initial investments in the reverse-osmosis, water-treatment unit from water savings.
- A feasibility study of the cogeneration plant at Gavrilovic shows the following results:

	Variant IA (part of electric energy sold to the National Grid)	Variant IB (electric energy produced only for plant's own use)
Investment outlays	$1.5 million	$1.5 million
Lifetime of the investment	15 years	15 years
Net savings (including operation costs)	$0.4 million/year	$0.25 million/year
Simple Payback Time	3.9 years	5.8 years
Internal Rate of Return	18%	12%

Table 2. Economic Benefits Demonstrated by Feasibility Study of Co-Generation Plant (Note: In the table only the two most profitable variants are listed.)

Lessons Learned

Several additional insights were gained during the implementation of this project. They provide further considerations for those interested in transferring the methods and technology established in this project to other contexts.

- The staff assigned to water and energy efficiency projects on a similar scale should work full time in developing and implementing them. Their time and efforts devoted to the project will pay off handsomely.

- Conducting a pilot test of the wastewater re-cycling facility generates several useful insights. Technicians, for example, gain particular knowledge (e.g., amount of water that can be re-cycled in a meat processing facility) that can be applied more generally to the full-scale design.

- Training and education of staff that are expected to implement the new water saving measures are crucial. Training materials including posters with photographs are self explanatory and good reminders of good and bad practices. The staff at Gavrilovic, once trained and educated on water saving techniques, implemented "good housekeeping" measures that lead to a 30% reduction in water consumption.

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